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The Impact of Teachers' Artificial Intelligence Competence on Students' Learning Outcomes in Junior Public Secondary Schools in Abuja Municipality, Nigeria

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Abstract: *Artificial intelligence (AI) is rapidly transforming the way teachers teach and students learn. This study investigated the impact of teachers' AI competence on students' learning outcomes in junior public secondary schools in Abuja Municipality, Nigeria. The study drew its foundation from the Technology Acceptance Model (TAM). It adopted a convergent research design to investigate the competence of teachers on AI pedagogy and its influence on students' learning. The target population comprised 10 principals, 340 teachers and 8569 students in public junior secondary schools in Abuja Municipality, Nigeria. Using purposive, census, stratified and simple random sampling, a total sample of 446 was gathered from principals, teachers and students. Semi-structured interviews, questionnaires and observation guides, validated through construct, content and face validity, were adopted as data-gathering instruments. The qualitative data were analyzed by means of thematic analysis with the findings presented in direct quotes and narrations, while the quantitative data were analyzed using descriptive statistics, such as percentages and frequencies, with the aid of the Statistical Package for the Social Sciences (SPSS) version 29.0. The hypothesis was tested through Pearson correlation analysis. The findings suggested that teachers' low AI competence limits the impact of AI on students' learning outcomes. The study points to the need for teachers' professional training on AI pedagogy and school-wide AI policies in the Nigerian basic education curriculum.*

Keywords: *Artificial Intelligence, Artificial Intelligence Competence, learning outcomes, Public Junior Secondary schools*

1.1 Introduction

Teaching and learning change and develop over time to respond to societal changes and global needs. The rise and rapid advancement of artificial intelligence have led to changes in teaching and learning across the world. Cole and Eda (2024) defined artificial intelligence as a technology that aids computers and machines to model how humans learn, comprehend, make decisions, solve problems, create and act autonomously. Artificial intelligence not only imitates humans but also living things such as dogs and flowers. It performs operations such as cognition, search, processing, logical thinking, inferences, and knowledge representation. Thus, artificial intelligence performs operations peculiar to living organisms.

According to Abioye et al (2021), AI includes subfields such as robotics, computer vision, machine learning, and knowledge-based systems.

Artificial intelligence (AI) is a subfield of computer science. Artificial intelligence is also considered to be a fundamental component or extension of Science, Technology, Engineering, and Mathematics (STEM) education (Hong et al., 2020). It relies and uses certain basic infrastructure for Information Technology and Communication (ICT), such as software and hardware. ICT software such as Windows, Google Workspace, Microsoft Office, database management systems, and ICT hardware such as desktop computers, internet routers, tablets, laptops, switches and smartphones are necessary to integrate AI in schools (D'Agostino, 2024; Elpis Groups, 2023; McNulty, 2024; Oyile et al., 2023).

The origin of artificial intelligence can be traced back to John McCarthy, who coined the term "artificial intelligence" as a field in 1956 (Natalia, 2023). The history of artificial intelligence dates back to ancient cultures and early philosophical inquiries. According to Bonaldo and Pereira (2023), the history of artificial intelligence is a journey of the human quest to develop technologies that replicate certain human behaviours and intelligence. The early concepts of AI can be found among philosophers like René Descartes and Gottfried Leibniz who delved into the idea of mechanical reasoning, and also among Mathematicians like George Boole and Ada Lovelace who delved into the idea of symbolic logic and computational thinking.

According to the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2023), artificial intelligence has been used in education for over forty years. Technology has been used to perform tasks peculiar to humans. The originators of the use of artificial intelligence in education were the psychologist named Sydney Pressey in the 1920s and the father of behaviourism, Frederic Skinner (Holmes et al., 2019). Sydney invented a device for evaluating, marking scripts and providing feedback to students. The machine was performing tasks that teachers should do. This machine relieved teachers of the burdens of marking and enabled them to focus on other important activities in the classroom (Pressey, 1926). Skinner extended the work of Presley in 1958 by inventing a machine that could help teach students (Pressey, 1926). The machine invented by Skinner foreshadowed the AI-powered intelligent tutoring systems commonly used in schools today. The use of artificial intelligence in education includes the use of virtual reality simulations, intelligent tutoring systems, data analytics, automated grading systems, and adaptive learning platforms. These tools, systems and algorithms are used to improve school administration, teaching, learning and assessment (Kitcharoen, et al., 2024).

In August 2023, the Nigerian government encouraged the integration of AI into teaching and learning in the country's curriculum (Amaka, 2023, Nwanguma, 2023). A number of teacher and student trainings have begun to aid the embedding of AI technologies in Nigerian schools. Online AI resources have been provided for students in primary and junior secondary schools with more than fifteen thousand (15,000) instructional content for students across the nation, according to the Minister of Education in Nigeria (Ozibo, 2025). To support the integration of the use of AI, Nigeria's Ministry of Innovation, Science and Technology launched a free AI Academy on December 19th, 2024, for all Nigerian students to equip them with AI fundamentals, AI ethics and real-world AI applications (Ministry of Innovation, Science and Technology, 2025). Curri AI an AI app for creating lessons also helps secondary school teachers to prepare, organize and teach using AI.

The use of AI in teaching and learning has been shown to enhance students' academic performance. According to Ahmad et al. (2021), AI can transform and improve teaching and learning. A study conducted by Harvard lecturers on 194 students of physics reveals that students who used AI Tutor in physics course learned twice more in a short time compared to those who did not use AI (Manning, 2024). AI helped the students to be motivated, engaged and able to study more materials. According to Ouyang et al. (2023), AI enhances students' engagement, collaboration and satisfaction with learning. AI is being used in higher institutions of learning to monitor, identify and predict students' performance. Some studies reveal that AI is a promising tool for accurately monitoring and predicting students' performance (Aydogdu, 2021; Tomasevic et al., 2020). This has helped educators ensure early intervention to students at risk of failure, thereby improving the academic performance of students. AI systems used for such purposes include tutoring systems, learning models, early warning systems and recommender systems. According to Baneres et al. (2019), AI systems such as early warning systems offer feedback and recommend interventions to students at risk of failure.

Studies reveal that teachers' AI competence enhances students' learning outcomes (Wu & Yu, 2023). Developing teachers' AI competence is essential in integrating AI into instructional practices in an AI-driven world. Alshammari and Al-Enezi (2024) researched the influence of AI on pre-service teachers' learning outcomes in Kuwait. The results indicate that the teachers are competent in the use of AI and have significantly enhanced their learning outcomes through the employment of AI. AI technology has optimized the quality of teachers' training, enhanced their teaching and learning skills and prepared them for the labour market. Teachers were able to effectively integrate AI into their lessons and learning activities. The results of the study align with Koh et al. (2021), who revealed that AI positively impacts teachers' learning outcomes. AI tools and systems support teachers, enhancing their performance and increasing their collaboration.

UNESCO (2024) enumerated five AI competencies every teacher needs. These include AI foundation and use, AI ethics, AI pedagogy, AI in professional development and the societal impact of AI. AI enhances teachers' teaching methods. AI helps teachers to be efficient in marking students' work, providing feedback and tailoring content to students' learning preferences. According to Kaplan-Rakowski et al. (2023), pre-service teachers view AI as a useful tool for their professional growth. Teachers' professional development on AI integration in teaching and learning will help students balance their harnessing of AI in their studies and also use AI beneficially.

In Morocco, Fakhar et al (2024) conducted a study on teachers' views and understanding of AI integration in public secondary schools. The results demonstrate that teachers have limited understanding of AI but are positive about the harnessing of AI in curriculum and instruction. The limited knowledge is attributed to teachers' lack of awareness and professional training on AI. The study also reveals that there is a strong correlation between teachers' AI perception and their educational level. Thus, there is an urgent necessity for professional training of AI teachers on AI to foster learners' readiness for the present and future world.

In South Africa, Mabotja and Ngulube (2024) highlighted that teachers recognize and appreciate the benefits of AI integration in teaching practices but are concerned about inadequate infrastructure and professional training of teachers on AI. Teachers' positive attitude towards AI integration in teaching and learning is a step towards successful AI implementation in schools as teachers are key determinants to

the successful AI implementation in schools. A similar study by Jere (2025) in South Africa evaluating the harnessing of AI in secondary school chemistry exams revealed that AI effectively answers questions and enhances teaching and learning. However, a study by Stanford University revealed that AI tool such as ChatGPT, though it hasn't increased cases of cheating, has nevertheless made it difficult for educators to identify plagiarizers (Morrone, 2024).

1.2 Statement of the Problem

An ideal academic system in this era of AI should integrate AI into traditional teaching and learning methods to refine and optimize teaching and learning experiences, bridge educational gaps and equip learners with the competence needed to thrive in an AI-driven world and workforce. Studies have shown that students' adoption of AI positively and significantly impacts their engagement and academic performance (Liu et al., 2025; Zawacki-Richter et al., 2019). According to Nigeria's National Digital Learning Policy (2023), the adoption of AI in schools should be balanced with traditional teaching methods so that learners can develop a range of skills. The policy encouraged teachers and school administrators to be trained on the effective harnessing of AI in a digital learning environment. Conducting a study on the integration of AI in teaching and learning is justified because teachers and students are exposed to AI tools through their phones and various devices. According to this policy, 99% of Nigerians aged 16 to 65 have smartphones and use the internet. The problem is that despite the potential of AI to enhance teaching and learning experiences, improve students' academic performance and prepare learners for the demands of an AI-driven workforce, the implementation of AI in public junior secondary schools in Abuja Municipality, Nigeria, remains underexplored and limited. Existing research shows that lack of infrastructure, inadequate funding, low digital literacy among teachers and concerns about the ethical use of AI hinder the use of AI in schools (Awoleye & Siyanbola, 2021). These hinder the effective and beneficial integration of AI in Nigerian schools. Recent school graduates lack the skills necessary to succeed in the workplace (Ademiluyi 2019). The National Bureau of Statistics reported that the rate of unemployment in Nigeria has risen to 33.3% (Adegboyega, 2021) and 88% of parents are concerned that schools are not teaching students how to use AI (Gordon, 2024). Many studies conducted on the integration of AI focus on higher education rather than junior secondary schools (Abanyam, et al., 2023; Alimi, et al., 2021; Ogunode & Ukorzo, 2023). The study being carried out fills these gaps by focusing on public junior secondary schools in AMAC, Abuja, Nigeria.

1.3 Research Question

How do teachers' artificial intelligence competence influence students' learning outcomes in public junior secondary schools in Abuja Municipality, Nigeria?

1.3.1 Hypothesis

The study tested the following hypothesis:

Ho_1: There is no significant relationship between teachers' AI competence and students' learning outcomes in public junior secondary schools in Abuja Municipality, Nigeria.

1.4 Literature review

In this section, theoretical and empirical review are presented.

1.4.1 Theoretical Framework Overview

The Technology Acceptance Model (TAM) underpins this study of the impact of teachers' AI competence on students' learning outcomes in junior public secondary schools in Abuja Municipality, Nigeria. This theory was propounded by Fred Davis in 1989. TAM is the leading model and foremost

scientific paradigm in investigating the acceptance and use of emerging educational technology by teachers, students and other educational stakeholders (Granić & Marangunić, 2019). The model states that the acceptance and adoption of technological innovation by technology users are shaped by two factors, namely perceived usefulness and perceived ease of use (Davis, 1989). Perceived usefulness denotes the subjective probability that the use of a technological tool will enhance one's life or occupational performance, whereas the perceived ease of use of a technological tool refers to the extent a user expects a technological tool to be operated effortlessly. Teachers' and students' perceived usefulness and ease of use of artificial intelligence tools can greatly influence their attitudes towards artificial intelligence tools and how they integrate them in schools. The perceived usefulness of artificial intelligence in teaching and learning encompasses the degree to which this technological innovation enhances teachers' professional duties and the output of both students and teachers. The Technology Acceptance Model is adopted here to study teachers' competence and utilization of artificial intelligence to impact students' learning outcomes. Teachers are critical stakeholders in the implementation phase of artificial intelligence literacy. They have the most interactions with artificial intelligence tools in the school. TAM has drawbacks such as limiting factors for technological adoption to perception and use. Other factors such as age, gender, experience and culture also influence the use of emerging technology. In view of the limitations of TAM, other theories such as Unified Theory of Acceptance and Use of Technology (UTAUT), Technological Pedagogical Content Knowledge (TPCK) and Raph Tyler's curriculum Model are complemented with TAM in the study for a holistic study and comprehensive understanding of the impact of teachers' AI competence on students' learning outcomes in Abuja Municipality, Nigeria.

1.4.2 Empirical Review

Teachers' AI competence generally involves two fundamental areas, namely teachers' AI knowledge and teachers' AI skills. Teachers' AI knowledge refers to teachers' theoretical knowledge and understanding of AI. It includes teachers' understanding of basic AI concepts, familiarity with AI teaching tools and awareness of ethical considerations and potentials of AI. Teachers need skills to implement AI in schools faithfully. Teachers' AI skills refer to the practical and pedagogical application of AI tools in teaching and learning. According to Bianco (2021), AI skill is one of the major challenges to the implementation of AI in schools. There exists a dearth of teachers equipped with AI skills to develop students' AI literacy. Very little information is also known about teachers' skills to effectively integrate artificial intelligence tools into teaching and learning processes (Kim et al., 2021; Ng et al., 2021). Teachers equipped with AI skills can effectively incorporate AI tools and systems into the classroom and faithfully implement the school curriculum. For instance, they can use AI tutors to make the lesson more engaging and can also use AI to tailor lessons to meet the varying learning needs, learning styles and preferences of students. AI digital competence of teachers includes being able to use basic AI applications, create content, manage information and connect with learners using technology (Ng et al., 2022).

Across the globe, Lindner et al. (2019) conducted a study in Germany on teachers' harnessing of AI in teaching and learning and discovered that 91.67 % of teachers do not have profound knowledge of artificial intelligence. Teachers are left to acquire the knowledge of AI on their own. The seamless implementation of artificial intelligence in school settings heavily depends on teachers' preparation and qualifications. Many teachers have heard of artificial intelligence and many are interested in it but only possess a rough experience and knowledge of artificial intelligence (Lindner & Berges, 2020; Lindner et al., 2019). The study suggested that there is a need for a detailed study investigating teachers' content

knowledge of artificial intelligence. This study fills this gap by investigating teachers' AI knowledge and skills.

Lin et al. (2022) conducted a study in southern China on the perspectives of teachers regarding sustainable AI education. Eighteen teachers participated in the study and grounded theory was employed. Classroom observation, action study, post-lesson discussion and semi-structured interviews served as instruments in obtaining data for research. Analysis of data was made using an inductive approach. The study reveals that teachers lack the knowledge for the proper incorporation of AI in educational contexts. The more teachers are exposed to AI educational tools, the more they will integrate them into teaching and learning and subsequently equip students with AI knowledge and skills (Alshammari & Al-Enezi, 2024). There is thus a prerequisite for teachers to have a competence development training on AI. Teachers' knowledge of AI is one of the major areas to consider when integrating AI into teaching and learning processes. According to the European Commission (2022), the rapid utilization of AI in today's world demands that teachers and students be equipped with the basic knowledge of AI and how to use it critically, positively, ethically and productively. The study used a small sample size of eighteen teachers. The study being carried out used a larger sample of 368 students, 68 teachers and 10 principals for increased validity.

Artificial intelligence can advance learners' critical thinking skills. Smith et al. (2023) conducted a study in the United Kingdom to examine the effect of AI on students' critical thinking skills. The target population was secondary school students. The research design employed was quasi-experimental. A purposive sampling technique was applied to sample 90 participants. The data collection instruments were questionnaires and an observation checklist. Paired sample t-tests and independent sample t-tests, and thematic analysis were used for data analysis. The result of the study is similar to that of Baskoro et al. (2023), who revealed that AI is effective in improving learners' critical thinking skills. The finding of the study above contrasts with Harvard Business Review (2023), which stated that AI can reduce students' creative and critical thinking skills. The finding also contradicts a survey conducted by The Reboot Foundation (2018), which revealed that out of 1000 adults surveyed, over 80% maintain that youths today lack critical thinking skills. Critical thinking skills are still critical in contemporary times. According to the World Economic Forum (2020), critical thinking skill is one of the top ten work skills for the year 2025. Whereas the objective of the aforementioned study was to know the impact of AI on learners' skills, the study being carried out goes beyond critical thinking skills to include the impact of AI on students' academic performance.

Artificial intelligence fosters students' written and verbal communication skills. A study was conducted by Park and Kwon (2024) conducted a study investigating the implementation of AI in middle schools in Korea. The study employed an experimental research design. The target population was middle school students and the researchers chose respondents based on a purposive sampling approach. Altogether, 23 students participated. Data was acquired through the use of questionnaires and observation guides. The findings reveal that artificial intelligence enhances students' understanding of AI, problem-solving skills together with interests in technology-related careers. The limitation of the aforementioned study is its small sample size of 23 and the use of only a quantitative research design. This study fills in this gap by using a mixed method and a large sample size of 446 comprising teachers, students and principals within the context of Nigeria to reduce bias that may arise from a single research method and from a single type of data.

Celik (2023) conducted a study in Turkey on teachers' knowledge of how to ethically integrate AI in education. Voluntary response sampling, together with simple random sampling procedures, were used. The researcher used an online survey to collect data from 428 teachers. Data was collected using online questionnaires. The researcher discovered that teachers who possess a greater knowledge of how to make leverage of AI tools have a deeper understanding of their pedagogical benefits. This implies that the more knowledge teachers have about AI and its utilization in education, the more they will know the benefits and succeed in equipping students with AI digital skills. Teachers' limited knowledge and skills in AI can affect the successful integration of AI in schools. It can also affect how teachers perceive AI and integrate it into the classroom. There is, therefore, a great need for teachers to be equipped with AI digital competence in order to prepare students for the demands of the new world (Ng et al., 2023). While the above study used only questionnaires to collect data, the study being carried out employs questionnaires, observation and semi-structured interviews to collect data.

In South Africa, Dlamini and Dewa (2021) delved into research on the extent of ICT adoption and utilization in teaching and learning processes in schools in South Africa. A mixed research design was employed and 192 teachers were purposively sampled. Questionnaires served as instruments to gather data. The results of the research indicated that ICT infrastructures are not evenly distributed, teachers have low ICT knowledge and skills as well as less utilization of ICT in teaching and learning processes. This reveals the need to adequately provide ICT facilities, empower teachers with the cognitive and practical skills on ICT and support their utilization of ICT gadgets in teaching and learning. According to Kemp et al. (2019), teachers' professional development and provision of resources are essential in ensuring the successful integration of AI in schools. Teachers' self-efficacy in ICT can boost their confidence in navigating the harnessing of AI in teaching practices. Teachers good at ICT and also interested in technology are more open to integrating AI in instructional practices (Hazzan-Bishara et al., 2025).

Musa et al. (2024), conducted a study on the AI literacy of teachers at a University in Southwestern in Nigeria. The researcher used a descriptive survey and 529 pre-service teachers participated in the study voluntarily. Google Forms survey was used for data collection and data collected was analyzed through the use of covariance-based structural equation modeling (CB-SEM). The study reveals that the in-depth understanding of AI by teachers predicts significant positive outcomes in its use, creation, ethics, detection and problem-solving. The study also revealed that there is no correlation between the knowledge of AI and the regulation of emotion. The study contributes insights into teachers' understanding and harnessing of AI. The study, however, is limited to university students and focuses only on a single institution which may differ from other institutions and other geographical regions thereby affecting its generalizability. The gaps in teachers' knowledge of AI can lead to misconceptions about AI and affect curriculum designs and classroom practices (Yau et al., 2023). The study being carried out fills in the gap by focusing on students in public junior secondary schools in Abuja.

A study conducted in Nigeria shows a contrary result. Adamu et al. (2020) undertook a non-experimental study to investigate the competence of vocational and technical teachers in using AI. The target population was teachers. The researchers used cluster sampling techniques and survey methods. Structured questionnaires served as instruments to source data. The results demonstrated that the teachers are proficient in the use of digital tools and that there exists a strong association between teachers' AI competence and their pedagogical experience but there is no significant relationship between

competence and gender. This study offers more insights into the proficiency of vocational and technical teachers in utilizing AI in teaching and learning. the study, however, does not specify the sample adopted in the research and the study is also confined to surveys. There is a need for further study using mixed methods and a specific sample size on the AI competence of teachers across various subjects in schools. The study being carried out fills in this gap as it employs a mixed research design.

1.5 Research Design and Methodology

The study employed mixed-method research, which combines quantitative and qualitative research techniques in a single study (Dawadi et al., 2021). Specifically, a convergent research design is employed in this research. Convergent research design involves giving equal priority to quantitative and qualitative data and collecting each of the data concurrently, analyzing the data separately and merging the results during interpretation for an integrated and robust conclusion (Creswell & Plano Clark, 2023; Younas et al., 2023; Younas & Sundus, 2022). The quantitative aspect of the study employed a cross-sectional research design, while the qualitative aspect used phenomenology. The target population in this study includes principals, teachers and students. A target population is a small group or specific sub-group of a broader population that meets certain criteria that the researcher is interested in and can identify and study (Creswell & Guetterman, 2021). The study targeted 10 public junior secondary schools comprising 10 principals, 8,569 students and 340 teachers in Abuja Municipality (Universal Basic Education Board, 2025). The purposive, census, stratified and simple random sampling techniques were used to select 446 samples. Different tools were used to facilitate data collection and they include questionnaires for students, semi-structured interview guides for teachers, semi-structured interview guides for principals and observation guides for AI resources and AI teaching and learning activities.

Face, content and construct validity were ensured through expert review, pilot testing, and triangulation. When test items are presented to educators, moderators, and testers, the validity of the items can be ensured (Bhandari, 2022; Milla et al., 2023). The dependability of the qualitative data collection tools was ensured through expert reviews, pilot testing, and triangulation. According to Bloomfield and Fisher (2019), internal validity can be assured through pilot testing. To determine the reliability of the quantitative data collection tool, internal consistency was applied in this study. The reliability coefficients ranged from .753 to .795, suggesting a high degree of internal consistency. According to Johnson and Christensen (2020), Cronbach's alpha shows the extent items interrelate.

A clearance letter was obtained from the Department of Post-Graduate Studies in Education. A study permit was obtained from the Universal Basic Education Board (UBEB) for the various public junior secondary schools in Abuja Municipality, Nigeria. Two research assistants were trained for two weeks for data collection. They were trained to ensure strict adherence to the ethical guidelines for conducting research, namely respect for persons, justice and beneficence. Statistical Package for the Social Sciences (SPSS) version 29 was used for analyzing the quantitative data using descriptive statistics and the results were presented in tables, charts and graphs to visualize the data. The Pearson Product-Moment Correlation Coefficient test was used since the research investigates the influence of teachers' AI competence on students' learning outcomes. The thematic analysis was used to manage and analyze the qualitative data efficiently.

1.6 Presentation, Discussion, and Interpretation of Research Findings

Demographic Information of the Teachers

The study sought teachers' demographic data, including age, educational levels and years of teaching. This is to assess and ensure representativeness and establish generalizability of the findings. The demographic data of the teachers is presented in Table 1.

Table 1: *Demographic Information of the Teachers*

	Category	Frequency	Percent
Age	Below 30 years	2	3.4
	30-40 years	18	30.5
	40-50 years	27	45.8
	51+ years	12	20.3
Education Level	NCE Nigeria Certificate in Education	14	23.7
	B.Sc. Ed	38	64.4
	PGDE	6	10.2
	MSC	1	1.7
Years in Teaching	0-10 years	13	22.0
	11-20 years	34	57.6
	21+ years	12	20.3

Source: *Field Data (2025)*

In terms of age distribution, according to Table 1, the largest proportion of teachers (45.8%) fell within the 40–50 years age bracket, followed by 30.5% aged 30–40 years, and 20.3% who were over 51 years old. Only a small fraction (3.4%) was under the age of 30 years, suggesting a workforce primarily composed of mid to late-career professionals. The largest proportion of teachers is within 40-50 years (45.8%) means that they may offer valuable insights and be influential in decision-making regarding the adoption of AI in public schools.

Influence of Teacher Artificial Intelligence Competence on Students' Learning Outcomes in Public Junior Secondary Schools According to Students

The study sought to know how teachers' artificial intelligence competence influences students' learning outcomes in public junior secondary schools in Abuja Municipality. On a 5-point Likert scale, the students expressed their agreement level with these statements relating to teachers' skill and knowledge of AI as shown in Table 2.

Table 2: Influence of Teacher Artificial Intelligence Competence on Students' Learning Outcomes in Public Junior Secondary Schools: Students' Responses

Statements	SD	D	N	A	SA	Mean	Std.dev
Teachers are always competent in identifying AI tools in everyday life	34 (10.9)	81 (26)	130 (41.8)	64 (20.6)	2 (0.6)	2.74	.93
Teachers always use practical examples to help me understand how to use AI in real life	47 (15.1)	72 (23.2)	109 (35)	79 (25.4)	4 (1.3)	2.75	1.04
My teachers always explain artificial intelligence topics in a way that I understand	38 (12.2)	52 (16.7)	138 (44.4)	79 (25.4)	4 (1.3)	2.87	.97

Our school teachers know how to effectively use AI to meet the learning needs of students	11 (3.5)	79 (25.4)	153 (49.2)	67 (21.5)	1 (0.3)	2.89	.78
Teachers always ensure that lessons are interactive and engaging using AI-powered technologies	25 (8)	96 (30.9)	108 (34.7)	81 (26)	1 (0.3)	2.79	.93
Teachers hardly use AI to make me understand topics better	22 (7.1)	78 (25.1)	111 (35.7)	98 (31.5)	2 (0.6)	2.94	.93
Our teachers always use AI to personalize and improve academic performance	8 (2.6)	70 (22.5)	166 (53.4)	65 (20.9)	2 (0.6)	2.95	.75
Our school teachers hardly encourage us to use AI tools in our assignments and projects	6 (1.9)	92 (29.6)	123 (39.5)	88 (28.3)	2 (0.6)	2.97	.83
Teachers always use AI to look for more teaching and learning materials	17 (5.5)	46 (14.8)	161 (51.8)	(82) 26.5)	5 (1.6)	3.04	.83
Our teachers always explain how AI can help us improve our academic performance	9 (2.9)	93 (29.9)	134 (43.1)	68 (21.9)	7 (2.3)	2.91	.85
AI always improves teaching and learning	18 (5.8)	13 (4.2)	107 (34.4)	132 (42.4)	41 (13.2)	3.53	.97
AI prepares me for the future world and career	28 (9)	19 (6.1)	81 (26)	140 (45)	43 (13.8)	3.49	1.09

Source: *Field Data (2025)*

As indicated in Table 2, regarding the ability of teachers to identify AI tools in everyday life, most students were neutral 130 (41.8%), while 81 (26%) disagreed and 34 (10.9%) strongly disagreed. Only 64 (20.6%) agreed and 2 (0.6%) strongly agreed. The mean score was 2.74, with a standard deviation of 0.93, reflecting low perceived competence in foundational AI recognition among teachers. When teachers cannot identify AI tools in everyday life, it means that the harnessing of AI in schools can go undetected, leading to increased academic dishonesty among learners. This may also suggest that professional training of teachers on AI pedagogy should include helping teachers identify common AI tools around them, as well as those AI tools students within that age group commonly use.

When asked whether teachers use practical examples to help students understand AI use in real life, 109 students (35%) were neutral, while 119 (38.3%) disagreed or strongly disagreed. Only 83 (26.7%) agreed or strongly agreed. The mean was 2.75, and the standard deviation was 1.04. This indicates limited application of relatable AI instruction and considerable variation in student experiences. It means that students may not learn how to use AI tools and systems to handle and address real-life problems. Education must be connected to real-life situations so that students can connect what they learn about AI to various aspects of life in society. AI is not just a future reality but also a present one. Students need to see and know how AI is put into use at home, in school, in hospitals, banks, farms, transportation, entertainment and others. Without connecting AI to real-world situations, students may run the risk of learning AI as an abstract and distant concept from their real world. They may thus complete school still uncertain about the relevance of AI in their lives and unprepared for AI-enhanced workplaces. Long and Magerko (2020) affirm this, stating that AI literacy must be contextual so that students can see its relevance in their lives.

In terms of teachers explaining AI concepts to students in an understandable way, 138 (44.4%) students were neutral, and 90 (28.9%) disagreed or strongly disagreed. Meanwhile, 83 (26.7%) agreed or strongly

agreed. The mean was 2.87, and the standard deviation was 0.97, showing mixed perceptions of teacher communication of AI topics in understandable ways. This suggests that students are not being engaged deeply on AI in ways that are concrete, relevant and developmentally appropriate. Failure to teach students about AI in ways that are understandable likely points to a problem in the method of lesson delivery. Instructional strategies are important in helping students understand content. Various instructional strategies should be incorporated into the school curriculum to help foster students' understanding of AI. Students showed mixed views on whether teachers can effectively use AI to meet students' learning needs: 153 (49.2%) were neutral, while 79 (25.4%) disagreed and 68 (21.8%) agreed or strongly agreed. The mean of 2.89 and standard deviation of 0.78 indicate moderate perceptions of teacher ability, with most unsure or unconvinced. This reinforces the need for differentiated instructional strategies so that teachers teach AI in ways that address the varying learning needs and preferences of middle school students.

Responses were less favourable for the statement that teachers make lessons interactive using AI-powered technologies. 121 students (38.9%) disagreed or strongly disagreed, and only 82 (26.3%) agreed. The mean was 2.79, and the standard deviation was 0.93, indicating low engagement with AI tools in lesson delivery. AI literacy is not about understanding AI concepts but also using AI to solve problems. The integration of AI in teaching and learning is not simply transmitting knowledge about AI to students but also using AI technologies to make the lesson interactive and interesting. Low engagement with AI may lower students' motivation and participation in the classroom and opportunities in this era and world of AI. It can be seen in a study conducted by Arslan et al. (2024) that increased harnessing of AI in the classroom enhances students' motivation, active participation and interaction with instructional content. There is thus a need to stress the adoption and harnessing of AI-powered educational tools to motivate and engage today's learners, as they are born and surrounded by AI-powered educational technologies.

Interestingly, when asked if teachers hardly use AI to make topics clearer, more students leaned toward disagreement: 111 (35.7%) were neutral, 98 (31.5%) agreed, and 100 (32.2%) disagreed or strongly disagreed. The mean was 2.94, and the standard deviation was 0.93, showing divided perceptions. This reflects an uneven harnessing of AI in the classroom. AI helps to simplify instructional content to the understanding of students. The use of AI to simplify depends on how well teachers understand and use AI in teaching. Teachers can use AI to identify materials and exercises that are adapted to students' developmental stages. Teachers' professional training should thus include how students can use selected AI tools to enhance the clarity of content taught in class.

Regarding the use of AI to personalize and improve academic performance, 166 (53.4%) students were neutral, 65 (20.9%) agreed, and 70 (22.5%) disagreed. The mean was 2.95, and the standard deviation was 0.75, suggesting uncertainty or minimal evidence of AI personalization from teachers to improve the academic performance of the learners. The minimal harnessing of AI to enhance students' academic performance may be due to inadequate digital facilities and lack of integration of AI in the school curriculum. AI has to be intentionally integrated into the school curriculum and instruction if it must improve students' academic performance. This finding suggests inconsistent exposure of learners to AI. It points to the need for teachers to not only use AI but also visibly model to students how to use it to enhance academic performance. Teachers' training on AI pedagogies should go beyond merely attending workshops on AI, to include practical and student-centered use of AI in the classroom. This will not only

help students to have a positive and clearer perception of AI but also help them know how to use AI to enhance their academic performance.

On whether teachers encourage students to use AI in assignments and projects, 123 (39.5%) students were neutral, and 98 (30.2%) disagreed. Just 88 (28.3%) agreed. The mean was 2.97, and the standard deviation was 0.83, again indicating limited encouragement from teachers and low variability across the respondents. Learning goes beyond the classroom. Students need to be independent learners and assignments and projects help them in that regard. A possible reason for the lack of encouragement from teachers on students using AI in assignments and projects could be the fear of academic dishonesty among students and the possibility of students not engaging in real learning due to the readily available answers from AI tools and systems. In addition, being that students come from families with varying socio-economic status, more gaps may be created between those who have access to technologies at home and those who don't.

Students responded slightly more positively to the statement that teachers use AI to source teaching and learning materials: 161 (51.8%) were neutral, while 88 (28.1%) agreed or strongly agreed. Only 63 (20.3%) disagreed. The mean score of 3.04 and standard deviation of 0.83 suggest moderate integration of AI in instructional planning. This suggests that the integration of AI in schools is still in its early stages. It also suggests that there is an underutilization of AI tools and systems by teachers, likely due to a lack of familiarity with the tools. With more support and training from the government and school heads, teachers will move from the moderate use of AI to a strong use of AI in school settings.

When asked if teachers explain how AI can help students improve their academic performance, 134 (43.1%) of the students' responses were neutral, while 93 (29.9%) disagreed and 75 (24.2%) agreed or strongly agreed. The mean was 2.91, and the standard deviation 0.85, showing low awareness-building efforts by teachers in this area. Thus, while teachers moderately use AI, they do not encourage students to do the same. This suggests that teachers value the harnessing of AI but lack how to guide students on its responsible and beneficial use. This is a serious limitation to equipping and preparing learners for a world heavily influenced by AI.

Students responded more affirmatively to the impact of AI on teaching and learning, with 132 (42.4%) agreeing and 41 (13.2%) strongly agreeing that AI improves teaching and learning. This concurs with previous research conducted by Bhutoria (2022) in China, India and the U.S that AI enhances learning. Among the responses of students, only 31 (10.0%) disagreed or strongly disagreed, and 107 (34.4%) were neutral. The mean score was 3.53, and the standard deviation was 0.97, indicating broad recognition of AI's effectiveness in enhancing teaching and learning. This reinforces the positive perceptions that AI enhances teaching and learning. AI is already being recognized among students as a valuable tool. This positive perception can impact the acceptance and adoption of AI on a full scale across middle school classrooms.

On the statement that AI prepares students for the future, 140 (45.0%) agreed and 43 (13.8%) strongly agreed, while 47 (15.1%) disagreed or strongly disagreed. The mean was 3.49, and the standard deviation was 1.09, showing a relatively strong belief among students that AI has long-term career relevance. A student remarked: AI gives me an understanding of what I want to become in the future" (Student 15, April 30, 2025). This shows that students are no longer relying onn the teachers to guide their choice of

careers neither are they limited to the traditional school guidance and counselling units to know and choose suitable career pathways. The present and future workplaces demand skills. The harnessing of AI helps learners develop skills such as communication skills, critical thinking skills, collaboration skills and digital skills, which are in demand in today's world. This concurs with the findings of prior research from Baskoro et al. (2023), Ouyang et al. (2023) and Smith et al. (2023) that AI fosters 21st-century skills essential in the job market.

The perception of the students on their teachers' AI competence was marked by inconsistency and, in some cases, outright deficiency. Students noted that teachers often struggled to apply AI tools practically, provide relatable examples, or guide ethical and critical engagement with AI technologies. As such, while students demonstrated curiosity and recognized the relevance of AI for their future, they also acknowledged that their learning was hampered by their teachers' limited AI knowledge and skills. This echoes the argument made by Lindner et al. (2019) in Germany, who found that over 90% of teachers lacked profound knowledge of AI and were often left to acquire this competence independently. Consistent with these findings, Celik (2023) also emphasized that the depth of a teacher's understanding of AI directly correlates with their capacity to integrate it meaningfully into pedagogical practices.

In this study, the situation is further worsened by the socio-economic divides and more so, by the infrastructural disparities. It is evident that students with access to smartphones and internet-enabled devices at home tended to benefit more from AI-driven learning opportunities both formally and informally. The benefits are, however, unevenly distributed as they depend on factors far beyond the classroom. The findings are further supported by the findings by Lin et al. (2022) and Ng et al. (2023) that teachers' own competence in AI are not only a matter of individual capability but are also shaped by institutional support, professional development opportunities, and access to digital tools. From a broader view, the findings indicate that teachers who possess AI skills are better positioned to personalize instruction, provide timely feedback, and enhance student engagement outcomes, well-documented in the literature (Park & Kwon, 2024; Kuswiyanti et al., 2023). Nonetheless, teaching remains traditional with no digital developments when such skills are unavailable. A further analysis was done to provide statistical evidence of any relationship between teachers' competence in AI and the students' academic performance. This was assessed through Pearson correlation analysis. The correlation matrix is presented in Table 3.

Correlation Matrix between Students' Learning Outcomes and Teachers' AI Competence

Table 3: Correlation matrix between Students' learning outcomes and Teachers' AI Competence

		Students learning Outcome	Teachers AI Competence
Students learning Outcome	Pearson Correlation	1	.426**
	Sig. (2-tailed)		.000
	N	311	311
Teachers AI Competence	Pearson Correlation	.426**	1
	Sig. (2-tailed)	.000	
	N	311	311

**. Correlation is significant at the 0.01 level (2-tailed).

Source: *Field Data (2025)*

A Pearson correlation analysis was conducted to examine the relationship between teachers' AI competence and students' learning outcomes. The analysis revealed a moderate positive correlation with a coefficient of r = 0.426 and a p-value of 0.00, which is statistically significant at the 0.05 level. Since the p-value is less than 0.05, the study therefore fails to accept the null hypothesis. This indicates that

there is a significant positive relationship between teachers' AI competence and students' learning outcomes in public junior secondary schools in Abuja Municipality. Therefore, as teachers' AI competence increases, students' learning outcomes also tend to improve. Thus, as teachers become more competent in using AI tools and strategies, students are more likely to exhibit improved academic performance. While the correlation does not imply causation, the result underscores the importance of enhancing teachers' digital and AI literacy as a potential driver of better student engagement, learning efficiency, and academic performance.

The correlation coefficient strengthens the qualitative narratives shared by students and supports prior research findings (e.g., Lindner et al., 2019; Lin et al., 2022), which emphasize that teacher preparation in AI is a key enabler of student learning in tech-enhanced environments. For instance, students who described their learning environments as "digitally rich" and guided by confident teachers often reported greater interest, motivation, and academic independence, echoing similar patterns seen in the findings of Park and Kwon (2024) in Korea and Kuswiyanti et al. (2023) in Indonesia. This finding also agrees with Musa et al. (2024), who found that teachers with strong AI understanding saw better results in using and applying AI in education. Their study highlights how AI knowledge helps teachers use the tools ethically and effectively. It supports the idea that teacher competence in AI is important to the learners' learning outcomes.

Similarly, Alshammari and Al-Enezi (2024) also reinforce this finding. They observed that when teachers gain more exposure to AI tools, they use them more in class. This helps students learn AI skills and improves classroom engagement. The current finding also aligns well with Baskoro et al. (2023), who add that AI use improves students' critical thinking. This fits the results, as better teacher skills could help students think more deeply. However, the findings contrast with the Harvard Business Review (2023), which warns that AI may lower creativity and critical thinking. This suggests the impact of AI might depend on how it is used. Skilled teachers may avoid these undesirable outcomes. The findings support the idea that teachers' AI skills boost students' learning outcomes.

Influence of Teacher Artificial Intelligence Competence on Students' Learning Outcomes in Public Junior Secondary Schools According to Teachers

The teachers were requested to briefly state the level of their AI knowledge and skills in relation to the basic concepts of AI, the harnessing of AI in teaching, the benefits of AI in education and ethical concerns about the use of AI. As reported by the teachers, their own familiarity with the basic principles of AI was found to be limited but gradually improving. Some teachers expressed that they only have a foundational understanding of AI. One participant noted: "Teachers have a basic concept of AI because some of us have gone out for training" (Teacher 48, May 6, 2025). This was gained mainly through informal means such as peer interaction or self-initiated exploration. For example, some reported learning about AI tools like ChatGPT and Meta AI only after being introduced to them by colleagues.

Teachers are using AI to amplify students' success in competitions. A participant expressed that "On the side of athletics under Physical Health Education, students performed wonderfully because we learnt it from AI" (Teacher 52, May 6, 2025). This suggests that teachers are using AI to outperform other schools in competitions. Teachers use AI to gain insights on how to best prepare students and also win competitions. This is a redefinition of what inter-school competitions mean in the era of AI. Teachers use AI to place students at an advantage. Thus, teachers not leveraging AI are placing their students at

increasing disadvantage. This supports the assertion made by Jon (2023) that more students will be placed at a disadvantage compared with their counterparts who use AI.

Most teachers have described, their AI use is for research and a few for lesson planning and instructional preparation, rather than as an active classroom tool. A participant stated that "I use AI and I know about ten teachers who use AI for research …others are learning from those who know about AI" (Teacher 23, May 2, 2025). Teachers' harnessing of AI is at the level of sourcing materials and making instructional content more understandable to students. Another participant mentioned that "AI helps in coordination, formulation of lesson notes and providing insights on how lessons can be delivered efficiently and effectively" (Teacher 34, May 7, 2025). AI was seen to enhance access to teaching materials, streamline information gathering, and support more efficient lesson planning. As one of the teachers has described, voice-enabled AI tools are useful in the generation of objective questions. Some of the AI tools include WhatsApp-based AI assistants. However, practical implementation in day-to-day teaching, particularly in student assessments and classroom activities, was minimal. Teachers attributed this to limited access to devices, insufficient infrastructure, and a lack of formal training in AI pedagogical integration. While some educators recognized AI's potential to enhance teaching efficiency and student comprehension, they stressed that actual application remains underdeveloped in most schools.

However, even with the limited reported practical usage, the teachers expressed generally positive perceptions of AI's educational benefits. They highlighted AI's potential to reduce workload, support differentiated instruction, and enhance student motivation. AI was viewed as a valuable tool for broadening research capabilities, especially in contexts where physical textbooks or learning materials were scarce. Furthermore, the teachers reported that AI improved the quality and accessibility of content, reduced preparation time, and made learning more engaging for students. A teacher remarked: "We use AI to boost our knowledge and then pass it down to the students" (Teacher 30, May 2, 2025). This means that in schools with some level of digital access, AI had already begun to serve as a substitute for traditional resources, helping bridge material shortages. Importantly, teachers saw AI not only as a technological asset but also as a means to spark curiosity and independent learning among students, more so when appropriately guided and integrated into the curriculum. While a few had begun integrating AI into their workflow for tasks such as lesson planning and content development, others admitted to relying heavily on traditional methods due to unfamiliarity with AI systems. Nevertheless, interviews suggested a growing interest in AI, especially where external training or resource persons had been invited to build staff capacity. The majority of the teachers remain in the early stages of AI awareness and have also described the need for structured, school-wide professional development to build confidence and competence.

Ethical concerns emerged with varying degrees of intensity across the responses. Some teachers were apprehensive about the risk of students accessing inappropriate content through AI tools or the internet, especially when unsupervised. A participant remarked that: "The students are not safe. It has exposed them to things they are not supposed to know yet. Most of the negative things students know and practice are from AI" (Teacher 5, April 30, 2025). This prompt calls for increased monitoring and adult supervision, particularly for younger learners. It suggests the need for the government to place certain age-appropriate filters on AI content so that students' harnessing of AI is guided by curriculum standards. This may prevent middle school students from accessing what they are not supposed to know or access. Some educators also raised concerns about data privacy, including the potential misuse of students'

personal data or unauthorized exposure to harmful material. However, others reported little or no personal concern, which may reflect either a low level of engagement with advanced AI applications or limited awareness of the broader ethical implications. Furthermore, the teachers were concerned about issues related to the accuracy of AI-generated information and the tendency for students to rely on AI tools for quick answers rather than having a deeper learning. Teachers stressed the importance of digital literacy education to foster ethical and critical harnessing of AI among students. This aligns with the findings of Er and Demirbilek (2023), who highlighted the need to educate middle school students on the ethical dimensions of AI.

The views shared by teachers regarding their knowledge and skills in artificial intelligence have illustrated that the use is complex but evolving. The critical influencers of the use are the training gaps, infrastructural constraints, enthusiasm and a growing awareness of ethical responsibility. While many teachers acknowledged that their understanding of AI was still in its formative stages, there was also a strong sense of curiosity and willingness to engage with the technology. As a participant noted: "AI makes learning faster and easier because it goes directly to the point. However, it makes the students lazy to open textbooks. For instance, my son prefers to use my phone to do assignments." (Teacher 7, April 30, 2025). Teachers use AI to reduce the stress of sourcing materials and keeping themselves current. Most participants noted that their knowledge of AI had been acquired informally through peer support, personal exploration, or sporadic exposure during workshops. This mirrors findings by Lindner et al. (2019), who highlighted that most educators lack formal AI training and rely on self-directed learning to navigate emerging technologies. Teachers in the study being carried out were able to identify basic uses of AI, particularly in lesson planning and information gathering. Tools such as voice assistants were appreciated for their convenience in generating exam questions or streamlining administrative tasks. Yet, despite these positive acknowledgments, teachers were largely hesitant to employ AI in real-time classroom instruction or assessments. This cautious approach was primarily attributed to limited digital infrastructure, a lack of access to devices, and insufficient professional development opportunities, challenges consistent with those identified in Lin et al.'s (2022) study in southern China and echoed in regional research by Dlamini and Dewa (2021) in South Africa.

Influence of Teacher Artificial Intelligence Competence on Students' Learning Outcomes in Public Junior Secondary Schools According to Principals

From the principals' point of view, in schools where there is some exposure to AI tools primarily through internet access and teacher use of digital search engines like ChatGPT and Google, AI is perceived as having a positive impact on both teaching and learning. Teachers are reportedly able to access relevant instructional content online to better prepare for lessons, which in turn improves the quality of teaching delivered to students. As a participant stated, "If there is anything the teachers don't understand, they can go online, Google it, and get a glimpse of it. So, it has really improved." (Principal 2, April 30, 2025). Furthermore, students with access to digital devices at home, such as laptops and smartphones, were described as having better familiarity with AI-related technologies. These students tend to perform better academically due to their exposure to digital resources and increased ability to engage in independent learning. However, this advantage is not evenly distributed, and principals acknowledged a clear digital divide: while some students thrive due to home access, others remain disadvantaged due to a lack of such resources.

Notably, one principal reflected the divided societal perceptions surrounding AI. They mentioned that some parents perceive AI as "evil." Other parents, however, support its use. This points to broader cultural and ethical concerns that may hinder AI adoption in schools and homes, particularly in more conservative or less digitally literate communities. This aligns with Makki and Bali (2021), who stated that one of the challenges to the implementation of a new technology is the lack of acceptance. On the other hand, principals from schools with no functional AI tools or internet infrastructure admitted that AI is not in use and therefore, no clear link can yet be established between AI integration and academic performance. One of the principals openly stated that: "To be honest, we don't use it, so there is not much to say whether it will affect their academic performance." (Principal 9, May 9, 2025). This highlights the disparity in AI adoption across schools, which is largely shaped by differences in infrastructure, teacher capacity, and policy support.

The principals were further asked to describe professional development programs to enhance teachers' AI competence in their schools. Most principals described increasing efforts to build teacher capacity through professional development programs aimed at digital and AI-related competence. These trainings are often organized by government agencies, particularly the Universal Basic Education Board (UBEB), as well as partner NGOs. Topics range from basic computer literacy to more specialized content such as website creation, software development, and entrepreneurship all foundational for navigating and integrating AI tools in education.

In some cases, gender-based initiatives and targeted symposiums have been introduced to promote inclusivity and diversify teacher and student participation in digital innovation. One principal recounted a recent event where female students were selected for a design-thinking program, while teachers received entrepreneurship training with AI components. This indicates an emerging recognition of the need for holistic, inclusive digital education programs to keep teachers and students current with new educational technologies and practices. This will not only equip teachers but also enhance their pedagogical practices and inspire the students to embrace the demands of the 21st century. However, exposing teachers and students is not enough. There is a need for a sustained practical training on the harnessing of AI in teaching and learning and daily life.

Despite these efforts, the implementation and effectiveness of such training vary. While some teachers return to their schools and cascade the knowledge to colleagues and students, others may not have the resources or institutional support to do so effectively. There were also contrasting experiences, with one principal stating "Nothing" in response to whether any professional development was in place, underscoring that not all schools are equally resourced or supported. Nevertheless, there are signs of progress. For example, one school received a donation of 40 computers from a government agency, enabling ICT teachers to introduce students to basic AI concepts. While still in its early stages, such initiatives suggest a growing awareness and institutional will to integrate AI into the education system, provided that schools continue to receive the necessary training and infrastructure.

There are several meta-analyses drawn from the merging of the data from students, teachers and principals. Findings from students, teachers and principals indicate an agreement that teachers have low AI knowledge and skills and need professional training on AI pedagogy. Teachers are unevenly exposed to professional training on AI. There is thus a complementarity in the responses of students, teachers and principals. In addition, some of the AI-literate teachers are unable to transmit the knowledge gained from

professional training with other teachers due to inadequate infrastructure. Continuous training of teachers on AI pedagogy will not only help them identify common AI tools but will also help them know how to use them effectively to enhance AI integration in teaching and learning, which will, in turn, improve students' learning outcomes. The provision of adequate AI infrastructure will assist teachers in disseminating and practically using the knowledge and skills gained from training on AI pedagogy in classrooms. Students, teachers and principals also agree that there is an uneven harnessing of AI in the classrooms as well as students' exposure to AI. From the views of teachers and students, the reasons for these are because students from urban schools and economically stable homes have access to these emerging technologies and tend to perform better academically due to their exposure to digital resources and increased ability to engage in independent learning, while those from rural regions and low-income homes do not have access to these tools and so are placed at disadvantage with their peers. The study revealed that there is a strong relationship between teachers' AI competence and students' learning outcomes thus, as teachers become more equipped with AI knowledge and skills, students' learning outcomes increase.

1.7 Conclusion

Conclusions are drawn from the merging of the qualitative and quantitative data. The merged findings offered deeper insights into the impact of teachers' AI competence on students' learning outcomes in public junior secondary schools in Abuja Municipality, Nigeria. From the findings, the study established that teachers have limited competence in AI, especially in terms of integrating AI meaningfully into teaching and learning. While some teachers demonstrated interest and basic understanding of AI concepts, their knowledge was often informal and acquired through peer interaction or individual curiosity. Although the findings recognized that teachers occasionally source teaching materials online or encourage AI for assignments, this was inconsistent and minimal. The harnessing of AI to personalize learning, make lessons more interactive, or illustrate real-life applications of AI was also found to be weak. In some schools, teachers use the internet and search engines to improve instructional planning, which has positively impacted lesson quality. However, full integration of AI in classroom teaching is rare. Barriers such as a lack of adequate training, limited access to devices, and the absence of institutional frameworks, infrastructural and financial constraints prevented broader adoption. The digital divide remains a persistent issue, with only students who have personal access to smartphones or the internet showing familiarity with AI concepts. While professional development programs for teachers do exist, often supported by UBEB or NGOs, their reach and effectiveness vary widely. Quantitative analysis further confirmed a moderate, positive, and statistically significant relationship between teachers' AI competence and students' learning outcomes. Ethical concerns were raised, particularly about unsupervised harnessing of AI by students, potential exposure to inappropriate content, and a growing dependence on AI that undermines deep learning. This underscores the need for AI literacy and responsible AI use in education, for students, teachers and principals.

1.8 Recommendations

Aligned with the study's findings and conclusions, key recommendations are provided.

1. **Recruit and Train More Teachers on AI Pedagogy.** By the next academic cycle, the Ministry of Education should recruit and train more teachers to be AI-literate. Recruitment efforts should also prioritize teachers with AI and ICT competence, and existing teachers should receive regular professional development on AI pedagogy. The Ministry of Education should provide in-service training workshops focused on the practical classroom harnessing of AI tools and not just

theoretical workshops. Schools should also encourage peer mentorship and knowledge-sharing among teachers to scale up AI integration more organically and promote collaborative learning environments.

2. **Teachers' Training on AI Pedagogy Should be Practically Reflected in the Classrooms**. Within the first two weeks after every professional training on AI pedagogy, teachers should practically use AI to differentiate instructional content, instructional strategies and assessments for students. Joining professional communities on the harnessing of AI in educational settings can help support the use of AI in different aspects of teaching and learning, particularly lesson preparation, lesson delivery and assessment. Teachers can collaborate with other teachers through the sharing of experiences, successes and challenges. This will help them integrate AI across all subjects. Teachers should also encourage students to participate in AI clubs, AI competitions and AI learning opportunities.

The faithful implementation of the above recommendations within the given time frames will not only help to close the gap between policies and actual practices on the side of the Ministry of Education but also address the gap between theory and practice on the side of teachers. These will help schools equip students with AI skills and knowledge, increase students' learning outcomes and prepare them to both succeed and lead in an era of AI.

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